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ABSTRACT

Three possible reasons for sex-related differences in science performance of 17 year olds were examined by analyzing total scores in three National Assessment of Educational Progress (NAEP) science booklets. Variables examined included spatial ability, attitudes toward science, and the use of the "I don't know" response. Because of an uneven distribution of spatial items across difficulty levels and a lack of attitudinal items in some of the booklets, this study focused on the "I don't know" response. A male-female difference in total scores was found with males scoring higher than females on pertinent items in all three booklets. Females used the "I don't know" response more often than males in one book and, in general, more often on items related to physical sciences. Several explanations are suggested as to why females may use the "I don't know" response more often than males: (1) they are more lacking in science knowledge than males, (2) they are more willing to admit their lack of knowledge, and (3) they are unwilling to take risks. (DC)

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Sex Differences in Science: "I Don't Know"[1]

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Gender differences in math and science performance have been frequently observed, and various explanations have been offered to account for these gender differences. In this study, National Assessment of Educational Progress (NAEP) science booklets were analyzed for gender differences in total score. Because the NAEP science items include "I don't know" as a response option, a unique opportunity existed to examine the role of "I don't know" responding in relation to total score.

Background

Male-female differences in performance have been found

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previously on NAEP math and science assessments by NAEP staff (e.g., Herman, 1975) and outside investigators (Fennema & Carpenter, 1980; Welch, 1981). Several categories of reasons have been offered for such differences. Some explanations posit a cognitive difference. A number of researchers (e.g., L. Harris, 1978; Maccoby & Jacklin, 1974; Peterson, in press) have suggested that females perform poorly on spatial visualization items. Others (e.g., Armstrong, 1979; California Assessment Program, 1979) have noted that females do better on computational items, males on multi-step problem-solving items.

Another group of explanations focus on experiential differences between males and females. Different course-taking experience for males and females has been proposed as a contributing factor to performance differences (Fennema & Sherman, 1978). Newcombe (in press) and Carlson (1977) have suggested that a difference in other experiences, such as out-of-school activities, could account for the performance difference. In addition, differential treatment of males and females within the same math and science courses has been observed (e.g., Brophy & Good, 1970; Stallings & Robertson, 1979; Delefes & Jackson, 1972; Dweck, Davidson, Nelson & Enna, 1978; Becker, 1981) and may contribute to differential learning.

Different attitudes towards learning math and science have also been cited as contributing to performance differ-

ences for males and females. Pedro, Wolleat, Fennema and Becker (1981) found that females, more than males, perceived math as not useful, which explained their less frequent enrollment in math courses. Other researchers have pointed out that females may have less confidence in their answers on math and science items. These researchers have looked at patterns of omitting responses (Wheeler & A. Harris, 1981; Rindler, 1980; Powers, 1981), choosing the "I don't know" response (dissertations by two of Lyle Jones' students, Sherman & Burton), and guessing (Powers, 1981; Pike, 1980).

The present study investigated the spatial visualization hypothesis, the attitude-toward-science idea, and patterns of "I don't know" responding.

Methods

The data used in this study came from the National Assessment of Educational Progress public-use data tape (Version 1). Three NAEP Science Assessment booklets on the tape from the 1976-77 assessment (numbers 4, 8, and 11) for seventeen-year-olds were analyzed. The National Assessment employs a deeply statified, nationwide, three- stage probability sample design with oversampling in extreme rural and in low income areas.[5]

For the purposes of this study, the first step required

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5. The reader unfamiliar with NAEP may request information and a publication list from NAEP, 1860 Lincoln St., Suite 700 PL, Denver, CO 80295.

was to construct a "test" out of the cognitive items in the booklet. A total score on the test consisting of the number of correct responses to the cognitive items was calculated for each respondent. Each person received only one of the science booklets. A total "I don't know" score was constructed by counting the number of "I don't know" responses to items. For the first analysis, items in booklet 4 were categorized by presence or absence of spatial visualization content and by the difficulty of the items. The authors judged each item as either tapping spatial ability or not. Level of difficulty was determined by the proportion of subjects passing an item. Three levels of difficulty were delineated, with separation points based on the distribution of the item p-values as illustrated in Table 1. Percentage of "I don't know" responding and percentage correct, within difficulty level, were compared between the sexes.

Insert Table 1 about here

Next, booklet 4 was examined to see if total score could be predicted from "I don't know" responses, after the effects of achievement and attitude were statistically removed using multiple regression. Separate regressions were calculated for each sex. Achievement, entered into the equation first, was defined as the total number of correct responses to items passed by at least 72% of the sample (i.e., a p-value greater than .72). Next, the five attitu-

dinal scales were entered into the equation. The attitudinal scales and their definitions are summarized in Table 2. Subjects responded to five-point Likert scales for each item. Finally, the total number of "I don't know" responses were entered to determine how much additional variance they would account for.

Insert Table 2 about here

Replication of the regressions was attempted for booklets 8 and 11. Affective items were not included in the replication because they were not available for booklets 8 and 11 and had not contributed to the explained variance in booklet 4. A follow-up analysis focused on an examination of items producing a large percentage of difference between males and females in "I don't know" responding. Items which produced greater than a 5% gender difference in the number of "I don't know" responses were examined in an effort to determine why these particular items produced gender differences in "I don't know" responding more than other items.

A brief examination indicated that questions relating to physical science seemed to be producing the larger "I don't know" differences. Questions were then categorized according to whether they mentioned key physical science words, such as energy, velocity, temperature, etc. (See Table 3 for full list.)

Insert Table 3 about here

Results

The distribution of total score and the split-half correlations for "I don't know" responses and total score indicated that the "test" constructed for each booklet was psychometrically acceptable in terms of these measures. The total scores varied widely across subjects, with no ceiling or floor effects. Odd-even split-half correlations boosted by the Spearman-Brown Prophecy Formula back to the full test length were used to estimate test reliability. Split-half correlations averaged .83 for total score and .89 for "I don't know" responses. In addition, the large sample size of subjects in the National Assessment made most results across subjects statistically significant.

A male-female difference in total score was found. Total scores, broken down by sex, are shown in Table 4. As can be seen, males had higher total scores than did females on all three booklets.

Insert Table 4 about here

Once the male-female difference was found in the total score, several factors were examined to see if they contributed to this difference. The first possible explanation

was the spatial visualization factor, as detailed in the Methods section. As shown in Table 1, spatial visualization content of certain items did not explain gender differences in total score for booklet 4. The gender differences observed in the means formed no clear pattern, due to the lack of power created by the small number of spatial visualization items. Also, the difference that was found on spatial items was confounded with difficulty level; that is, the spatial items were substantially more difficult than the non-spatial items. There were too few difficult, non-spatial items and easy, spatial items to be able to discern the role of each dimension separately. Therefore, analysis of spatial visualization content was not pursued in booklets 8 and 11.

Because the spatial visualization content of items did not clearly contribute to the gender difference in total score, attitudes toward science were examined. These science attitudes, as measured by the attitudinal items described in Methods, neither accounted for any substantial variation in total score in booklet 4 nor differentiated between the sexes (Table 5). Comparable attitudinal items were not included in the other booklets. Thus, differing attitudes toward science (as measured by items in booklet 4) were not responsible for the male-female difference in total scores.

Insert Table 5 about here

Next, "I don't know" answers to the science questions were investigated to see if a gender difference in uncertainty contributed to the gender difference in total score. Figure 1 shows the distribution of "I don't know" responses for booklet 4, which is representative of the distributions for the other booklets. More males than females never chose the "I don't know" response, as shown in Figure 1. Also, females answered "I don't know" more frequently than did males on all three booklets (Table 4). In booklet 4, "I don't know" responses accounted for twice as much variation in total score for females than for males (8% vs. 4%; Table 5). This small but promising difference in the amount of variation in total score accounted for by "I don't know" responding[6] did not hold up in replication in booklets 8 and 11 (Tables 6 & 7), which led to another investigation of item content.

Insert Figure 1 about here

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6. Because of the lack of homoscedasticity of variance across the scale of "I don't know" responses, the validity of the use of regression in this situation was questionable. Therefore, the analysis was repeated using a scale transformation to reduce the heteroscedasticity and again using dummy variables grouping subjects based on their "I don't know" responses. The same results as in the original analysis were found.

Insert Tables 6 & 7 about here

All items were categorized according to physical science content, as described in Methods. Items with more than a five per cent gender difference in "I don't know" responding were identified and compared in content to items without such a difference. This content analysis revealed that the large male-female differences in "I don't know" responding occurred on physical science items.

Table 8 shows the correlation between item type (physical science or not) and the male-female difference in "I don't know" responding. For contrast, the correlation of item type with male-female difference in total score is also shown. For each item, the difference score was constructed by finding the difference between the male and female "I don't know" scores or total scores. That difference score was then related to the presence or absence of physical science content for that item. The correlation coefficient describes the relationship between the male-female difference and the item type. The higher correlation coefficients indicate that the "I don't know" difference score is related to physical science content. The correlations between total score and item type are not high, an indication that physical science content of items is contributing more to "I don't know" responding by females than to correct answers by males. Overall, the physical science

content analysis was successful in pinpointing a major factor in the gender difference in "I don't know" responding, which in turn contributes to the gender difference in total score.

Insert Table 8 about here

Discussion

The study examined three possible explanations for the gender-related differences in performance on the NAEP science items: spatial content, attitudes toward science, and use of the "I don't know" response. Because spatial items were not well distributed across difficulty levels and attitudinal items were lacking in some booklets, the investigation of the first and second hypotheses was hampered. The discussion here concentrates on the "I don't know" response. We will offer explanations for the observed differences in "I don't know" responding and some recommendations for future analyses of National Assessment data.

The most straightforward explanation for use of the "I don't know" response is that the respondent does not, in fact, know the answer to the question. Research in other areas has shown that females admit negative feelings such as anxiety more readily than males do (Maccoby & Jacklin, 1974). It is also possible that females are more willing to admit their lack of knowledge of science than males are.

The males who answer the questions, though, do so more effectively than do the females who select answers, so that answering "I don't know" may reflect actual lack of knowledge, rather than lack of confidence.

Why would females lack knowledge of science and why would they be more willing to admit it? For females, knowledge of science is more likely to rest upon school experience than it is for males, as females have fewer out-of-school experiences and hobbies related to science than do males (Newcombe, in press; Fox, 1977; Carlson, 1977). Further, females take fewer elective courses in science than do males (CBEDS, 1981). Once females are in a science class, the stereotyping of science as masculine (Vockell & Lobonc, 1981), the psychologically troublesome experience of being different from everyone else (Kanter, 1977; Frank & Katcher, 1975; Vockell & Lobonc, 1981), and the differential treatment and expectations of teachers for males and females (Brophy & Good, 1970) may all contribute to less effective learning. The low participation of women as scientists in the workforce (Vetter, 1981) and the failure of adult women to keep informed of current events related to science (Miller, Suchner, and Voelker, 1980) create a societal context in which young women are allowed to avoid participation in science, particularly physical sciences and engineering.

With such a cultural backdrop, it is not surprising that young women are more likely to respond "I don't know,"

especially to physical science items, but additional psychological factors may be operating. A lack of confidence or an unwillingness to take risks may also lead females to avoid giving a definite answer. Not guessing an answer also has the advantage for females that it avoids being either "right" or "wrong." Being "right," especially on a physical science item, is consistent with being "smart," a status that females may avoid because of conflict with social relationship goals (Stein & Bailey, 1973; Lockheed, 1975). Being "wrong" is, however, not a viable alternative since it conflicts with the socialization of females to be "good," which includes cooperating with teachers and, by extension, testers. Thus, saying "I don't know" provides females with an alternative to two unpleasant choices.

For males, the "I don't know" response has less value. First, males are expected to know about science, particularly physical science (Vockell & Lobonc, 1981). Second, they are expected to take risks. It is better to have guessed and been wrong than to admit uncertainty by saying "I don't know." Further, males are sometimes found to be less realistic than females about estimating their likelihood of success on an academic task and may overrate their potential (Maccoby & Jacklin, 1974). Thus, they may not realize that their confidence is unjustified and may in fact get the correct answer by chance. For these reasons one would expect less frequent use of the "I don't know" option by males than females.

Table 1

Means and Standard Deviations for Items With and Without Spatial Visualization Content, Science Booklet 4, 17-Year-Olds

Items With Spatial Visualization Content	N of Items	Total Score (percent)						I Don't Know Score (percent)			
		Male		Female		Total		Male		Female	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Easy[1]	2	94.4	4.53	89.8	3.75	92.1	4.13	2.0	1.06	4.2	.78
Moderate[2]	7	75.8	10.17	67.1	7.03	71.5	8.26	7.0	7.85	11.6	8.01
Difficult[3]	7	36.1	8.42	29.2	9.32	32.7	8.01	12.9	9.17	18.6	10.66
Items Without Spatial Visualization Content											
Easy[1]	11	92.5	2.91	93.2	2.91	92.8	2.83	2.4	1.24	2.2	1.38
Moderate[2]	16	72.3	9.59	69.8	11.35	71.1	10.2	6.0	3.70	7.6	4.36
Difficult[3]	8	37.4	9.11	33.5	6.08	35.5	6.81	11.5	5.44	17.1	8.57

[1] Easy items were those solved correctly by 85% or more of respondents.

[2] Moderate items were those solved correctly by between 50% and 85% of respondents.

[3] Difficult items were those solved correctly by 50% or fewer of respondents.

Several constraints limited our comparison of this study with other research and point out some of the unusual features of the National Assessment. NAEP is quick to admit that the Assessment is not a test in the usual sense of the word: 1) it is not balanced with respect to content. In this case, the prevalence of physical science items biases the assessment against those who have not taken elective science courses. 2) it is not speeded. We do not know how this contributed to our findings. 3) it allows the "I don't know" response. We believe that the "I don't know" format introduces confidence or risk-taking as a factor in performance by some students. Further analyses of NAEP data should take these three features into account. Females' unwillingness to guess, however, would be better investigated by observations and interviews in a variety of settings so that avoidance of risk-taking may be more clearly defined and related to academic performance.

Table 3

Key Words for Physical Science Content Analysis

acceleration	atomic model	atomic structure	cars	chemical	compound	electron	energy	football	heat	matter	molecule	organic	particle	power
pressure	radiation	speed	temperature	velocity	wave	weight	x-rays							

Table 2

Items Forming Attitudinal Scales from Science Booklet 4, 17-Year-Olds

Liking of science

How often are science classes boring?
How often are science classes fun?
How often do you like to go to science class?
How often do science classes make you feel: uncomfortable, curious, stupid, confident, successful, unhappy?

Attitude towards teachers

How often have science teachers:
- encouraged you to state your opinion?
- recognized your right to have your own opinion?
- admitted that they don't know something?
- encouraged you to think for yourself?
- taken a personal interest in you?

Perception of usefulness of science

Science classes are useful.
The things you learn in science classes have nothing to do with the real world.
Science should be required in school.
Much of what you learn in science class is useful in everyday life.
Much of what you learn in science class will be useful in the future.

Participation in science

How often have you done each of the following activities when not required for science class?
- read science articles in magazines
- read science articles in newspapers
- watched science shows on TV
- gone to hear people give talks on science
- read books about science or scientists
- talked about science topics with your friends
- done science projects
- worked with science-related hobbies

How often are you afraid to ask science questions in class?

For you, how often are the things you studied in science class too difficult?

Table 4

Means and Standard Deviations on Science Booklet Scores*

	N	Total Score		I Don't Know Score		Achievement Score**	
Booklet 4		Mean	SD	Mean	SD	Mean	SD
55 items							
(22 in Achievement Score)							
Males	1564	36.5	7.8	4.2	5.0	19.2	3.0
Females	1571	34.4	7.2	5.7	5.7	18.9	2.9
Booklet 8							
59 items							
(19 in Achievement Score)							
Males	1535	29.5	7.2	4.7	5.8	15.9	2.8
Females	1534	27.0	6.4	6.1	6.2	15.6	2.7
Booklet 11							
54 items							
(20 in Achievement Score)							
Males	1546	32.7	8.0	3.7	4.6	15.4	2.9
Females	1595	31.2	7.5	4.8	4.9	15.6	2.9

* All means computed with respect to possible number of items

** Composed of those items solved correctly by 72% or more of respondents

Table 5

Summary of Regressions of Selected Variables on Total Score for Science Booklet 4, 17-Year-Olds

Order Entered	Variable Entered	R	R^2	ΔR^2	A
		Males			
1st	Achievement Score[1]	.83	.69	.69	.68
2nd	Attitudinal Scales[2]	.85	.73	.04	--[3]
3rd	I Don't Know Score	.87	.76	.04	-.23
		Females			
1st	Achievement Score[1]	.81	.65	.65	.64
2nd	Attitudinal Scales[2]	.82	.68	.03	--[3]
3rd	I Don't Know Score	.87	.76	.08	-.33

[1] Composed of those items solved correctly by 72% or more of respondents

[2] Table 2 describes the Attitudinal Scales

[3] All attitudinal weights were less than .1

Table 7

Summary of Regressions of Selected Variables on
Total Score for Science Booklet 11, 17-Year-Olds

Order Entered	Variable Entered	R	R^2	ΔR^2	β
			Males		
1st	Achievement Score[1]	.82	.68	.68	.73
2nd	I Don't Know Score	.84	.70	.02	-.18
			Females		
1st	Achievement Score[1]	.84	.70	.70	.74
2nd	I Don't Know Score	.85	.73	.03	-.19

[1] Composed of those items solved correctly by 72% or more of respondents

Table 6

Summary of Regressions of Selected Variables on
Total Score for Science Booklet 6, 17-Year-Olds

Order Entered	Variable Entered	R	R^2	ΔR^2	β
			Males		
1st	Achievement Score[1]	.78	.61	.61	.65
2nd	I Don't Know Score	.81	.65	.05	-.26
			Females		
1st	Achievement Score[1]	.77	.60	.60	.65
2nd	I Don't Know Score	.80	.65	.05	-.26

[1] Composed of those items solved correctly by 72% or more of respondents

Figure 1

Frequency of "I Don't Know" Responses for

Science Booklet 4, 17-Year-Olds

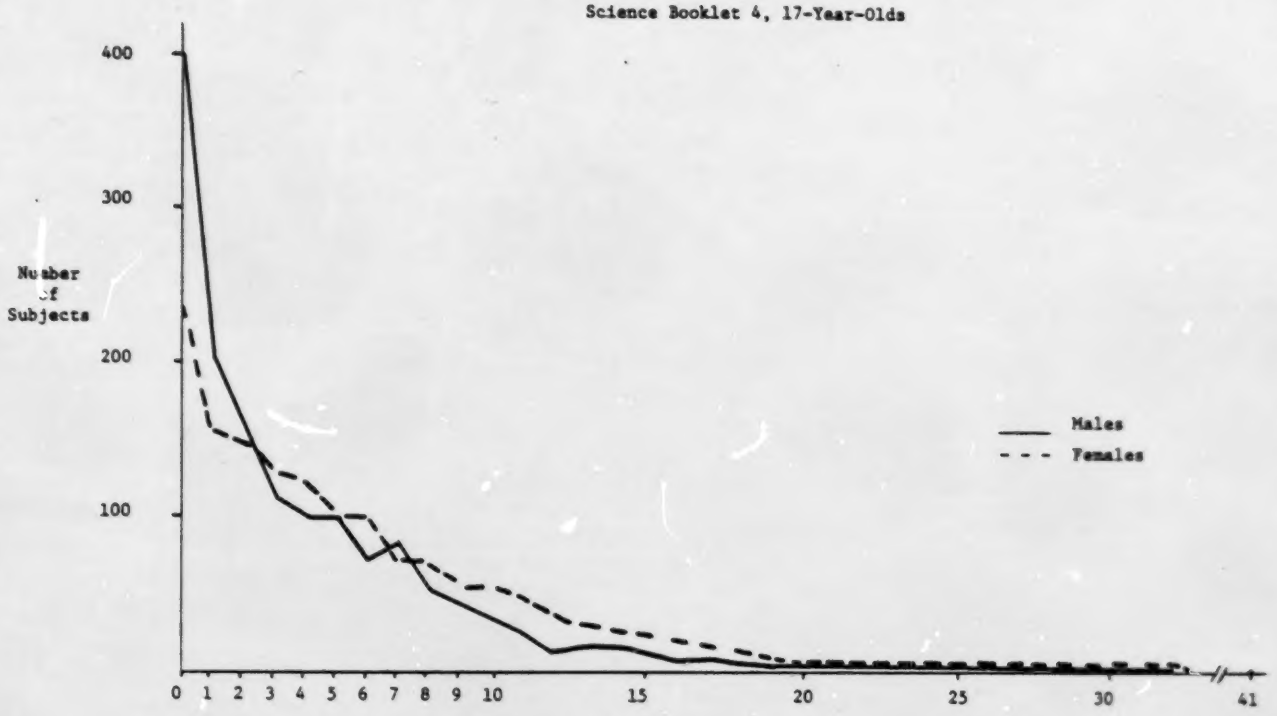

Table 8

Correlations[1] Between Physical Science and Non-Physical-Science Item Types[2] and Difference Scores[3] for Science Assessment, 17-Year-Olds

Difference Scores	Booklet 4	Booklet 8	Booklet 11
"I Don't Know" (female minus male)	.55	.20	.62
Total Score (male minus female)	.36	.03	.24

[1] Refer to the text for a full description of the construction of this table.

[2] Item Types: 1 = non-physical science,
2 = physical science

[3] Difference Scores = difference between male and female scores

References

Armstrong, J. M. A national assessment of achievement and participation of women in mathematics. Education Commission of the States, 1979.

Becker, J. R. Differential treatment of females and males in mathematics classes. Journal for Research in Mathematics Education, 1981, 12 (1), 40-53.

Brophy, J. E., & Good, T. L. Teachers' communication of differential expectations for children's classroom performance: Some behavioral data. Journal of Educational Psychology, 1970, 61, 365-374.

CBEDS (California Basic Educational Data System). Student enrollment by subject in California public schools for 1980-1981. Sacramento, CA: California State Department of Education, 1981.

California Assessment Program. Sex differences in mathematics achievement. Excerpt from Student Achievement in California Schools, 1977-78 Annual Report. Sacramento CA: California State Dept. of Education, 1979.

Carlson, M. Sex differences in performance on the IEA science test items. Unpublished doctoral dissertation,

University of Pittsburgh, 1977.

Delefes, P., & Jackson, B. Teacher-pupil interactions as a function of location in the classroom. Psychology in the Schools, 1972, 9 (2), 119-123.

Dweck, C. S., Davidson, W., Nelson, S., & Enna, B. Sex differences in learned helplessness II, The contingencies of evaluative feedback in the classroom and III, An experimental analysis. Developmental Psychology, 1978, 14, 268-276.

Fennema, E., & Carpenter, T. P. Sex-related differences in mathematics: Results from National Assessment. 1980.

Fennema, E., & Sherman, J. Sex-related differences in mathematics achievement and related factors: A further study. Journal for Research in Mathematics Education, 1978, 9, 189-203.

Fox, L.H. Sex differences: Implications for program planning for the academically gifted. In J.C. Stanley, W.C. George, & C.H. Solano, (Eds.), The gifted and the creative: A fifty year perspective. Baltimore: Johns Hopkins University Press, 1977.

Frank, H.H., & Katcher, A.H. Perceptions of freshwomen dental and medical students by their freshmen peers. In M.F. Lockheed (Ed.), Research on women's acquisition of professional and leadership roles. Princeton, NJ:

Educational Testing Service Research Bulletin, Dec. 1975.

Harris, L. J. Sex differences in spatial ability: Possible environmental, genetic, and neurological factors. In M. Kinsbourne (Ed.), Asymmetrical functions of the brain. London: Oxford University Press, 1978.

Herman, M. (Compiler). Male-female achievement in eight learning areas. National Assessment of Educational Progress, Denver, Colorado, 1975.

Kanter, R.M. Men and women of the corporation. New York: Basic Books, 1977.

Lockheed, M.E. Female motive to avoid success: A psychological barrier or a response to deviancy? Sex Roles, 1975, 1 (1), 41-50.

Maccoby, E. E., & Jacklin, C. N. The psychology of sex differences. Stanford, California: Stanford University Press, 1974.

Miller, J. D., Suchner, R., & Voelker, A. M. Citizenship in an age of science. New York: Pergamon Press, 1980.

Newcombe, N. Sex-related differences in spatial ability problems and gaps in current approaches. In M. Potegal (Ed.), Spatial orientation: Developmental and physiological bases. New York: Academic Press, in press.

Pedro, J. D., Wolleat, P., Fennema, E., & Becker, A., Election of high school mathematics by females and males: Attributions and attitudes. American Educational Research Journal, 1981, 18 (2), Summer: 207-218.

Peterson, A. C. Sex differences in performance on spatial tasks: Biopsychosocial influences. In Significance of sex differences in dyslexia. Boston: The Orton Society, in press.

Pike, L. W. Implicit guessing strategies of GRE-attitude examinees classified by ethnic group and sex. GRE Board Professional Report GREB # 75-10P. Princeton, NJ: Educational Testing Service, 1980.

Powers, D. E. Effects of taking the SAT on rate of work and guessing. College Board Research and Development Reports RDR 80-81, #4. Princeton, NJ: Educational Testing Service, 1981.

Rindler, S. E. The effects of skipping. Ed. and Psych. Measurement, 1980, 40 (4), 989.

Stallings, J., & Robertson, A. Factors influencing women's decisions to enroll in advanced mathematics courses. Final Report, SRI International Project 7009. Washington, D. C.: National Institute of Education, 1979.

Stein, A.H., & Bailey, M.M. The socialization of achievement orientation in females. Psychological Bulletin,

1973, 80, 345-366.

Vetter, B.M. Degree completion by women and minorities in sciences. Science, 1981, 212, 35.

Vockell, E.L., & Lobonc, S. Sex-role stereotyping in high school females in science. Journal of Research in Science Teaching, 1981, 18 (3)May, 209-219.

Welch, W. W. Investigation of male-female differences in science performance: Learner characteristics or learner experiences? Paper presented at National Association for Research in Science Teaching symposium, The Research Process in Science Education, April 1981, New York.

Wheeler, P., & Harris, B. Comparison of male and female performance on the AIP physics test. College Board Report #81-4. New York: College Entrance Examination Board, 1981.